

FORM PTO-1390 (Modified) — U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE REV 10-95		IC10 Rec'd PCT/PTO 27 FEB 2002
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NUMBER <div style="font-size: 1.2em; margin-top: 5px;">1934/13</div>
INTERNATIONAL APPLICATION NO. <div style="font-size: 1.2em;">1200/00553</div>	INTERNATIONAL FILING DATE <div style="font-size: 1.2em;">10 SEP 2000</div>	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.5) <div style="font-size: 1.5em; margin-top: 5px;">10/069618</div>
PRIORITY DATE CLAIMED <div style="font-size: 1.2em;">10 SEP 1999</div>		
TITLE OF INVENTION <div style="font-size: 1.1em; margin-top: 5px;">INTRAVASCULAR DEVICE AND METHOD USING IT</div>		
APPLICANT(S) FOR DO/EO/US <div style="font-size: 1.1em; margin-top: 5px;">Elchanan BRUCKHEIMER</div>		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1). 4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c) (2)) <ol style="list-style-type: none"> a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau) b. <input type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)). 7. <input checked="" type="checkbox"/> A copy of the International Search Report (PCT/ISA/210). 8. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made, however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made 9. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 10. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). 11. <input type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409). 12. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)) 		
Items 13 to 18 below concern document(s) or information included:		
<ol style="list-style-type: none"> 13. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 14. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included 15. <input type="checkbox"/> A FIRST preliminary amendment <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment 16. <input type="checkbox"/> A substitute specification 17. <input type="checkbox"/> A change of power of attorney and/or address letter. 18. <input type="checkbox"/> Other items or information 		

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.101) 10/069618		INTERNATIONAL APPLICATION NO. 1200/00553		ATTORNEY'S DOCKET NUMBER 1934/13	
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20. The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : <input type="checkbox"/> Search Report has been prepared by the EPO or JPO \$ 890 <input checked="" type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) \$ 710 <input type="checkbox"/> No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$ 740 <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$ 1040 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$ 100 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS PTO USE ONLY <div style="border: 1px solid black; padding: 5px; width: 100%;">\$ 710</div>	
Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)) <input type="checkbox"/> 20 <input type="checkbox"/> 30					
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	13 - 20 =		x \$ 18		
Independent claims	1 - 3 =		x \$ 84		
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					
TOTAL OF ABOVE CALCULATIONS =				\$ 710	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable) <input checked="" type="checkbox"/>					
SUBTOTAL =				\$ 355	
Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)) <input type="checkbox"/> 20 <input type="checkbox"/> 30 +					
TOTAL NATIONAL FEE =					
Fee for recording the enclosed assignment (37 CFR 1.21(h)) The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable) <input checked="" type="checkbox"/>				40	
TOTAL FEES ENCLOSED =				\$ 395	
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☒ Please charge my Deposit Account No **06-2140** in the amount of **\$ 395** to cover the above fees.
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NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

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SIGNATURE
MARK M. FRIEDMAN
 NAME
33,883
 REGISTRATION NUMBER
25 FEB 02
 DATE

INTRAVASCULAR DEVICE AND METHOD USING IT

FIELD AND BACKGROUND OF THE INVENTION

This invention relates to intravascular devices, and to methods of treatment using such devices.

5 Many forms of congenital heart disease result in shunting of the blood from the high resistance left-ventricle-aorta circuit into the low resistance right ventricle pulmonary artery circuit. This blood returns to the heart instead of going to the body and overloads the left ventricle causing congestion. This condition, known as congestive heart failure, is associated with difficulty in breathing and increased
10 energy expenditure causing failure to thrive in the case of an infant. An additional and no less important aspect of such a shunt is the exposure of the lung blood vessels to high flow rates and pressures which eventually cause irreversible damage.

The solutions to the problems imposed by a large shunt include: medication to reduce the shunt, and repair of the heart defect by surgery or pulmonary artery
15 banding [PAB]. This latter option, PAB, is employed today in cases when repair of the defect is not possible due to defect type or infant size or as a first stage palliative procedure for complex congenital disease.

PAB involves a surgical procedure under general anesthesia during which the chest is opened and a band of synthetic material is placed around the main
20 pulmonary artery and tightened relatively arbitrarily to increase the resistance to flow. During the surgery pressures and oxygen saturation can be measured to evaluate the hemodynamic effect of banding however this does not always correlate well with findings after surgery. Apart from the general disadvantages of surgery [wound, scar, possibility of infection], surgical PAB can lead to distortion of the
25 pulmonary arteries due to band migration. In addition if the band is too tight or loose it cannot be adjusted without additional surgery. Once the band has served its purpose it has to be removed by surgery and the damaged area of the pulmonary artery is repaired. This is usually performed during the repair of the underlying defect.

The fields of cardiac catheterization and angiography have changed immensely with the introduction of transcatheter therapeutic/interventional techniques. It is now possible to close cardiac defects, relieve narrowings of systemic, pulmonary and coronary arteries, occlude accessory vessels, biopsy the heart and open valves through a small entry site, less than 2.5-3mm, in the groin. These procedures obviate the need for surgery, including open heart, while affording excellent results. This minimally invasive approach avoids scarring and affords a more rapid recovery. The transcatheter procedure is usually performed on an overnight or same day basis thereby significantly reducing hospital stay and costs. A common example is the use of stents instead of bypass surgery in coronary artery stenosis.

An additional form of disease amenable to transcatheter therapy is pulmonary embolism. This condition is the result of blood clots which form in a vein of the lower part of the body and break loose, migrating to the lungs. One form of treatment of these emboli is by inserting a filter in a blood vessel such as the vena cava to interrupt the travel of these emboli. One such filter is disclosed in U.S. Patent No. 4,425,908. Devices currently in use require relatively large sheaths for insertion, and are usually irretrievable.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an intravascular device which can be delivered to a desired location by use of a catheter.

It is a further object of the invention to provide a method for treatment of certain intravascular diseases using an intravascular device which can be delivered to a desired location by use of a catheter.

In one aspect of the invention, there is provided an intravascular device for positioning in a blood vessel and capable of being delivered to the blood vessel in a catheter, comprising a platform on which functional structures may be mounted, or with which they may be integrally formed. The platform is preferably composed of a shape memory alloy, such as Nitinol, and is configured to form a collapsed folded

conformation in which it can be straightened for transcatheter delivery, and is further configured to subsequently form an expanded ring conformation. The properties and design considerations for shape memory alloys are now well documented and will not be discussed here in detail.

5 Thus, according to the teachings of the present invention there is provided an intravascular device for minimally invasive deployment within a vessel, the intravascular device comprising a closed loop of flexible material configured to assume a first state in which the closed loop is folded on itself and straightened to allow delivery through a minimally invasive delivery system and, when deployed, assumes a
10 second substantially ring-shaped state to become lodged against an inner wall of the vessel.

 According to a further feature of the present invention, the closed loop is formed from a shape-memory alloy preset to the second substantially ring-shaped state, the closed loop being subsequently deformed to assume the first state prior to delivery.

15 According to a further feature of the present invention, the substantially ring-shaped state is implemented with a curvature configured such that advancing of the loop in a feed direction from a delivery system results in deployment of the loop in a direction generally perpendicular to the feed direction.

 In the present disclosure, the following terms have the indicated meanings:

20 *platform* – a supporting structure on which functional structures may be mounted, attached or integrally formed. The platform will generally be fixable to the walls of the blood vessel. The platform itself generally does not have a function other than to support other functional structures. Examples of functional structures which may be supported by the platform include, but are not limited to, a pulmonary artery
25 band for regulating blood flow, a filter for emboli and a valve.

ring conformation – a circular band having an internal bore.

shape memory alloy – a metal alloy which exhibits shape memory properties, namely, which returns to a predefined shape when exposed to a temperature above a given phase transformation temperature. As is well known for minimally invasive
30 medical procedures, the shape memory alloy may advantageously be designed to as

to be stored in a deformed state at room temperature while reverting to its predefined shape at body temperature

Shape memory alloys compatible with the device of the invention may be based on various metals such as iron, copper or nickel, as long as they are biocompatible. A preferred shape memory alloy is Nitinol, which is made from nickel and titanium in approximately equiatomic amounts or a slight increase of nickel. A description of Nitinol may be found, *inter alia*, in U.S. Patent No. 4,425,908 whose contents are incorporated herein by reference. Small changes [less than 1%] in the percentage of nickel in the alloy confer large changes in the properties of the alloy, particularly with respect to the transformation temperature. A preferred Nitinol alloy will comprise a weight percentage of 55-56% nickel in order to have shape memory and superelastic properties at body temperature. A most preferred alloy will comprise 55.1-55.6% nickel.

The use of a shape memory alloy imparts to the device the property of retrievability. The latter is of considerable importance in transcatheter implantations of expanding devices since the now expanded device usually makes transcatheter removal unfeasible, even after a short period of time. Complications of implantation, particularly incorrect positioning or migration, may require removal of the device and repositioning. If the device cannot be collapsed down to its original size and reinserted into the delivery sheath, then its removal by a transcatheter method may be impossible and surgery required. This can be avoided by using the device of the invention.

In a preferred embodiment, the platform of the device comprises a breakable section, that is, a portion which allows a gap to be introduced into the continuity of the ring, as will be further exemplified below. This facilitates cancellation of the effect of the device *in situ* by breaking it, in a case where the device is no longer needed.

In another aspect of the invention, there is provided a method for reducing the diameter of a blood vessel comprising:

- (a) inserting into a catheter a intravascular platform as defined above in a collapsed conformation, wherein an inflatable band in an uninflated state is mounted on the platform;

- (b) delivering the device to the blood vessel by introducing the catheter into the blood vessel;
- (c) ejecting the device out of the catheter into the lumen of the blood vessel, whereby the platform assumes an expanded ring conformation; and
- 5 (d) inflating the inflatable band.

In a still further aspect of the invention, there is provided a method for filtering emboli in the blood stream comprising:

- (a) inserting into a catheter a intravascular platform as defined above in a collapsed conformation, wherein a filter is mounted on, or integrally formed with, the platform;
- 10 (b) delivering the device to the blood vessel by introducing the catheter into the blood vessel; and
- (c) ejecting the device out of the catheter into the lumen of the blood vessel, whereby the platform assumes an expanded conformation.

15 BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

20 **Fig. 1** is a sectional front view of one embodiment of the device of the invention;

Fig. 2A is an enlarged partial view of the platform portion of the device of Fig. 1;

Figs. 2B, 2C and 2D are enlarged partial views of portions of the view of Fig. 2A;

25 **Figs. 3A and 3B** are enlarged sectional views of the device of Fig. 1. Fig. 3A is a front view and Fig. 3B is a side view 90° perpendicular to Fig. 3A;

Fig. 4 is a sectional plan view illustrating another embodiment of the device of the invention in an expanded conformation;

Fig. 5 shows the embodiment of Fig. 4 in a collapsed conformation;

Figs. 6A, 6B, 6C and 6D illustrate a schematic representation of the delivery of the device of the invention to a desired site in a blood vessel;

Fig. 7 illustrates a further embodiment of the platform of the invention; 7A is before expansion and 7B is after expansion;

5 **Fig. 8** illustrates a still further embodiment of the platform of the invention; 8A is before expansion and 8B is after expansion;

Figs. 9A and 9B illustrate an implementation of a Nitinol ring particularly effective for achieving transverse deployment of the platform of the present invention relative to a deployment catheter, the ring being shown in a straight state prior to
10 deployment and in its deployed state, respectively;

Figs. 9C and 9D are a side view and a front view, respectively, showing the Nitinol ring of Figures 9A and 9B during deployment from a catheter; and

Fig. 9E is an enlarged view of a part of the ring of Figure 9B showing an additional optional feature of the present invention.

15 DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to Fig. 1, there is illustrated one embodiment of an intravascular device according to the invention, being an intravascular pulmonary artery band, generally designated 2. The device is shown in its expanded conformation, and comprises a ring-shaped platform 4 defining an inner aperture or
20 bore 5. An inflatable annular band 6 is coaxially mounted on the platform 4 within the aperture 5, the width of the band correspondingly reducing the diameter of the aperture. In this embodiment, the device functions as an internal transcatheter pulmonary artery band for use in the treatment of congestive heart failure due to congenital heart disease. The ring fixes the band into place by exerting pressure on
25 the inner pulmonary artery wall.

The platform portion of the device is in a ring shape in the expanded conformation. The dimensions of the ring may easily be determined by the skilled man of the art, depending on the dimensions of the blood vessel to be occluded, for example by biplane angiography. Preferably, the ring diameter will be approximately

2 mm larger than the native pulmonary artery internal diameter. For example, if the artery diameter is 8 mm, the ring diameter will be 10mm. Each additional size may be 2mm larger, e.g. 12mm, 14mm, 16mm etc, to accommodate for larger pulmonary artery diameters.

5 The platform 4 is composed of a shape memory alloy such as, e.g. Nitinol. The structure of the platform may be composed of one or more strands of Nitinol of varying diameters. One example of the structure of the ring is shown in Fig. 2A, which illustrates one thick 8 and two thin 10 Nitinol strands interwoven into a lattice. In many cases, slight oversizing of the ring structure is sufficient to retain the device
10 in place. The thicker strand may optionally attach to the inner wall of the pulmonary artery by having a serrated, bumpy edge 12 (Fig. 2B). Additionally, or alternatively, further retention may optionally be provided by provision of several small hooks 14 (Fig. 2C) which penetrate the inner lining of the artery. Deep penetration of the artery wall by the hooks is prevented by the adjacent loops 16 of the Nitinol strand
15 which "cushion" the band against the arterial wall (Fig. 2D).

 The band 6 may be composed of any flexible material which does not interact with the blood. To form an adjustable band, balloons may be attached to the Nitinol ring. These balloons will preferably be composed of an inert, biocompatible material such as silicon. The attachment of the band to the platform is illustrated in Fig. 3. In
20 a preferred embodiment, the platform becomes part of the silicone balloon on its lateral aspect by having the balloon "melted" on during device manufacture.

 The band may be comprised of one or more coupled inflatable balloons. Figs. 4 and 5 illustrate one embodiment of the invention in which the device 18 comprises a band 20, consisting of two linked sausage-shaped balloons 22 & 24, mounted on a
25 platform 26. The balloons are expanded by pushing fluid into them via a feeding catheter 28 which feeds the balloons through an elastic collar 30 which is attached to the balloons. The fluid may be isotonic saline at body temperature or a colloid at higher osmotic pressure so that fluid will not seep out. Preferably, the fluid is saline.

 The collar is held open by a reinforced end region of the feeding catheter
30 which extends through an aperture in the center of the collar. The balloons are joined

by a connector 32 which may open at a predetermined pressure [e.g. 1-2 atms] to allow for the second balloon to be expanded, if required. The balloons may also be concentrically positioned within the platform (see Fig. 6D). Thus, the diameter of the band may be adjusted, depending on the hemodynamic status of the blood vessel.

5 The decision whether to further expand or reduce the size of the balloons [by feeding or withdrawing fluid] is determined by hemodynamic measurements taken during band implantation. In order to insert the device in a catheter, the device is collapsed into its folded conformation (Fig. 5), with the band in an uninflated state.

The delivery of the illustrated embodiment of the device to a desired location
10 in a blood vessel is exemplified in Figs. 6A-D. The device 34 is maintained in a collapsed conformation while in the delivery catheter 36. The delivery catheter contains within it a feeding catheter 38 enveloped by a release catheter 40. The delivery catheter is advanced in the artery 41 to the desired location in the blood vessel, at which the device 34 is extruded into the arterial lumen 42 (Fig. 6A). As the
15 device 34 is advanced out of the catheter, the platform 44 expands to its preformed shape within the lumen 42 and attaches to the inner wall 46 of the artery (Fig 6B). Once the ring is in its optimal position, the band is inflated through the feeding catheter.

The preformed shape of the ring is such that a ring is formed at a right angle
20 to the axis of the delivery catheter (Fig. 6C). For example, the connection between the Nitinol ring and delivery system may be given a preformed shape of 90°. Alternatively, the delivery catheter may be angled at its end so that the ring protrudes at an angle when advanced out of the catheter.

Figures 9A-9E show a particularly preferred configuration of the Nitinol ring
25 itself for implementing the aforementioned 90° turn on deployment of the platform 44. Specifically, the shape memory material is here preset to a form resembling an open pair of jaws (Figure 9B) exhibiting a roughly circular form in plan view while having roughly a C-shaped form in side view (Figure 9C). The C-shaped curvature ensures the required transverse deployment as the device is gradually released from
30 the delivery catheter 36 (Figures 9C and 9D).

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the balloon. The ring will be breached due to the presence of a breakable section, and the fluid will leak out of the torn apart balloons. The Nitinol ring and silicone may then become part of the pulmonary arterial wall and become covered by endothelium (the inner lining). Or alternatively the band can be removed by a definitive surgical procedure.

In order for the Nitinol ring to be 'breakable', a weak link may be created in the platform. One example is illustrated in Fig. 7. A thick Nitinol strand 50 is folded for a small distance creating an area 52 which can be unfolded and expanded 54 at a later stage during a catheterization procedure, by advancing a high pressure balloon of a larger diameter than the platform through the lumen of the band and expanding the balloon to the desired diameter.

An alternative approach is illustrated in Fig. 8. The ends 56 of the thick Nitinol strand meet inside a stiff sleeve 58 in which they overlap but are not connected. The sleeve provides support for the broken platform by not allowing the platform to collapse or fold in on itself. However when the platform is expanded by a high pressure balloon, the ends of the Nitinol strand come apart. The balloons are broken at the connector.

A further embodiment of the device of the invention is a vena cava filter for pulmonary emboli. The device of the invention would comprise a platform as described above and a filter. The filter may be made of crosslinks of Nitinol wire attached to the filter and since these are made of shape memory alloy they can be folded easily into the delivery catheter. The fixation of the platform *in situ* would be by diffuse pressure of the ring on the vessel wall, preventing deep penetration of the hooks as described above with respect to the pulmonary band.

A still further embodiment using a platform of the invention could include a form of transcatheter cardiac or vessel valve. Examples of valves which could be mounted on the platform are pericardial valves, bovine, pig, etc. or synthetic material.

Although several preferred embodiments have been described above, the scope of the invention is defined by the following claims.

WHAT IS CLAIMED IS:

1. An intravascular device for minimally invasive deployment within a vessel, the intravascular device comprising:
a closed loop of flexible material configured to assume a first state in which said closed loop is folded on itself and straightened to allow delivery through a minimally invasive delivery system and, when deployed, assumes a second substantially ring-shaped state to become lodged against an inner wall of the vessel.
2. The intravascular device of claim 1, wherein said closed loop is formed from a shape-memory alloy preset to said second substantially ring-shaped state, said closed loop being subsequently deformed to assume said first state prior to delivery.
3. The intravascular device of claim 2, wherein said alloy is Nitinol.
4. The intravascular device of claim 1, wherein said substantially ring-shaped state is implemented with a curvature configured such that advancing of said loop in a feed direction from a delivery system results in deployment of said loop in a direction generally perpendicular to said feed direction.
5. The intravascular device of claim 1, further comprising an inflatable device mechanically linked to said ring.
6. The intravascular device of claim 1, further comprising an intravascular filter structure mechanically linked to, or integrally formed with, said ring.
7. The intravascular device of claim 1, further comprising a valve member mechanically linked to said ring.
8. The intravascular device of claim 1, wherein said closed ring includes a breakable section.

9. The intravascular device of claim 1, wherein a band is mounted on said closed ring.

10. The intravascular device of claim 9, wherein said band includes at least one inflatable balloon.

11. The intravascular device of claim 10, wherein said balloons are made of silicone.

12. The intravascular device of claim 9, wherein the diameter of said band is adjustable.

13. The intravascular device of claim 9, wherein said band is a pulmonary artery band.

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(54) Title: **INTRAVASCULAR DEVICE AND METHOD USING IT**

(57) Abstract: An intravascular device for minimally invasive deployment within a vessel includes a closed loop of flexible material configured to assume a first state in which the closed loop is folded on itself and straightened to allow delivery through a minimally invasive delivery system. When deployed, the loop assumes a second substantially ring-shaped state to become lodged against an inner wall of the vessel. The loop is preferably formed from a shape memory alloy preset to the second state and temporarily deformed to assume said first state during deployment.

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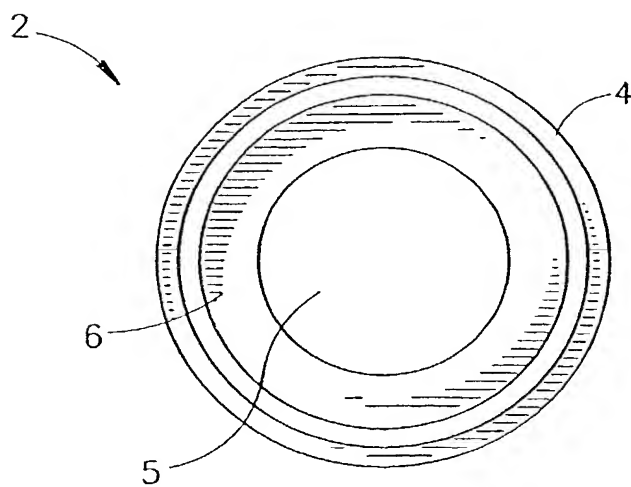


FIG. 1

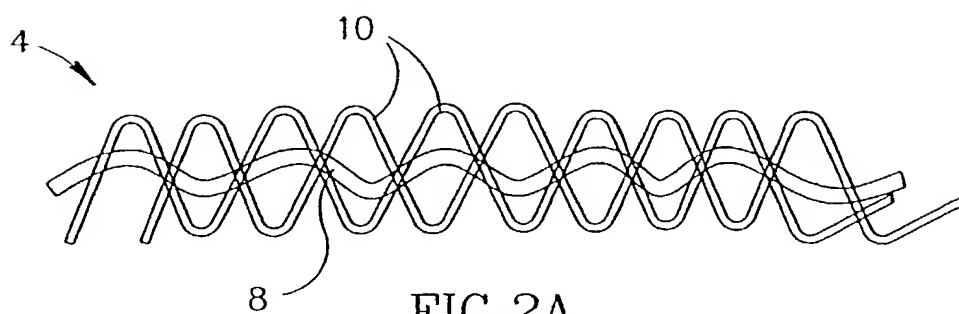


FIG. 2A



FIG. 2B

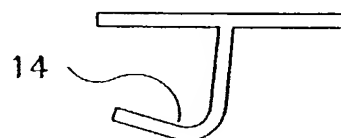


FIG. 2C

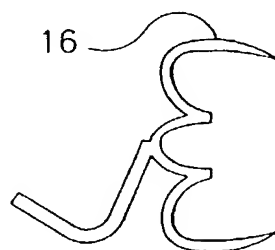


FIG. 2D

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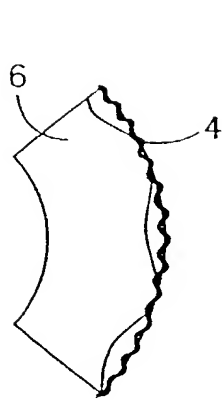


FIG. 3A

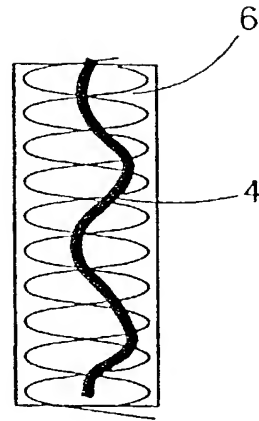


FIG. 3B

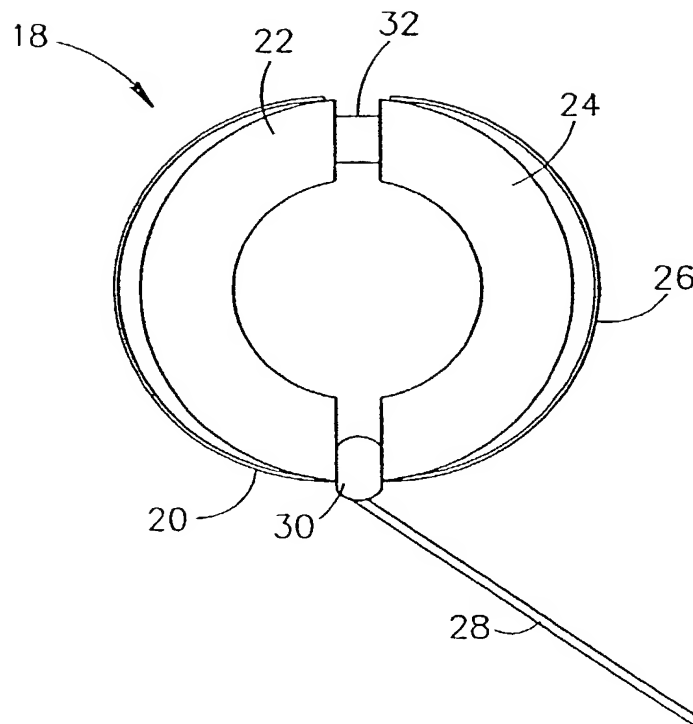


FIG. 4

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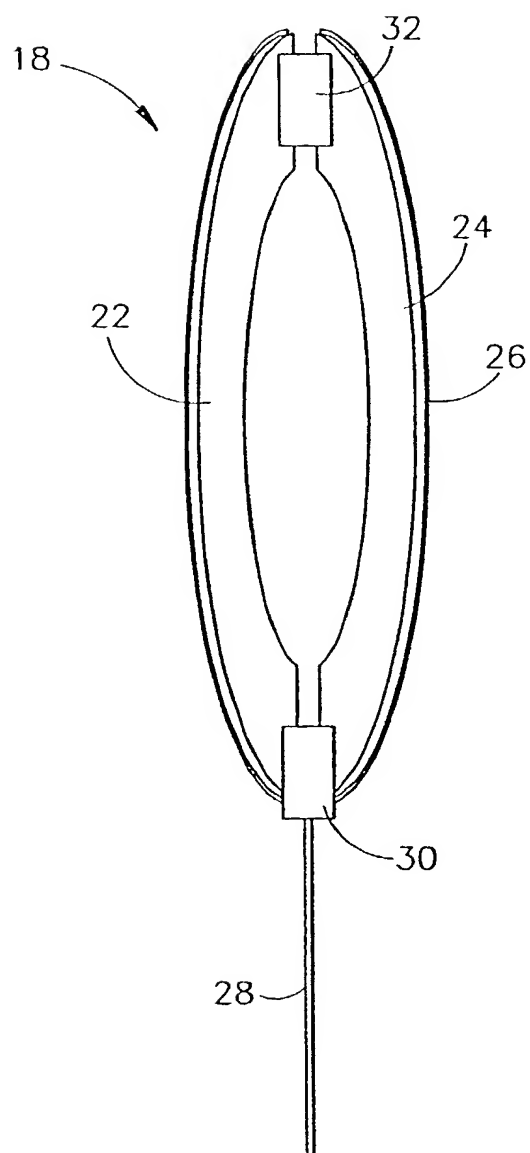


FIG. 5

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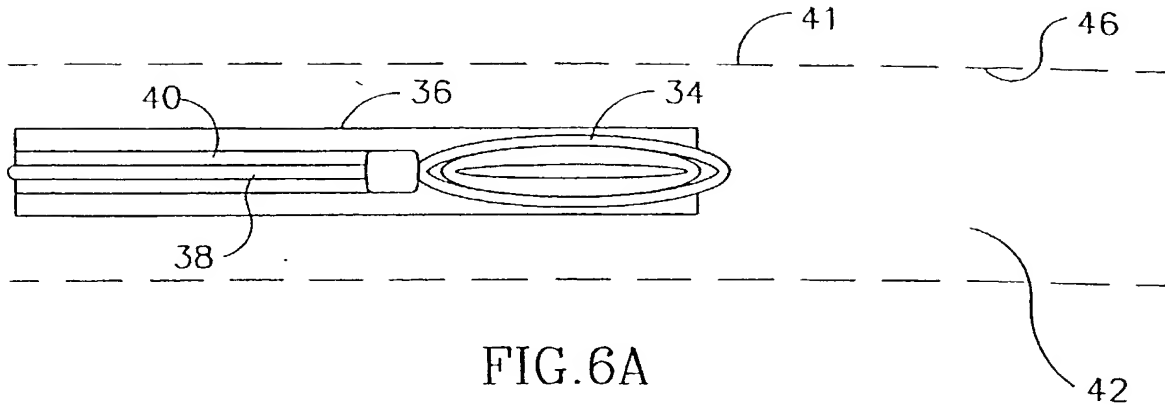


FIG. 6A

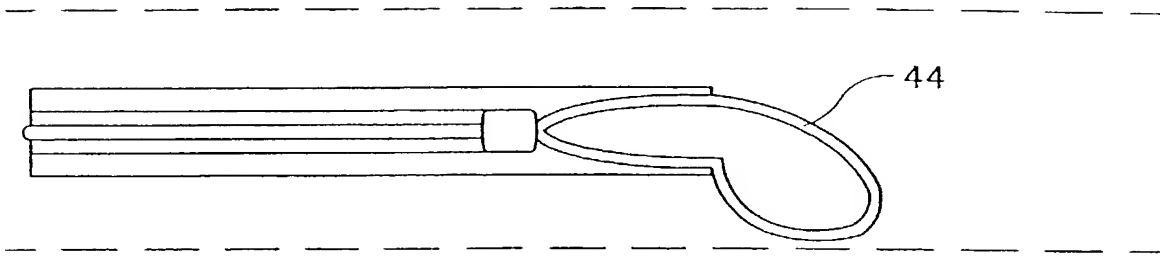


FIG. 6B

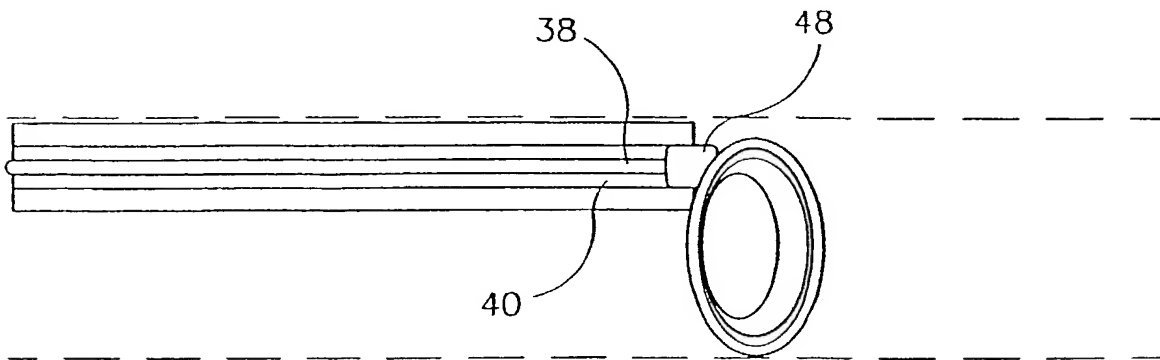


FIG. 6C

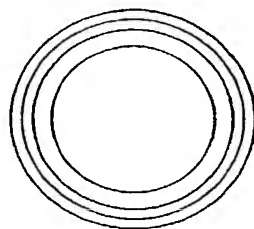


FIG. 6D

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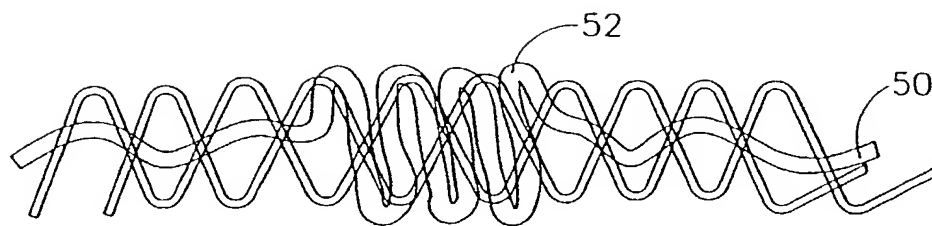


FIG. 7A

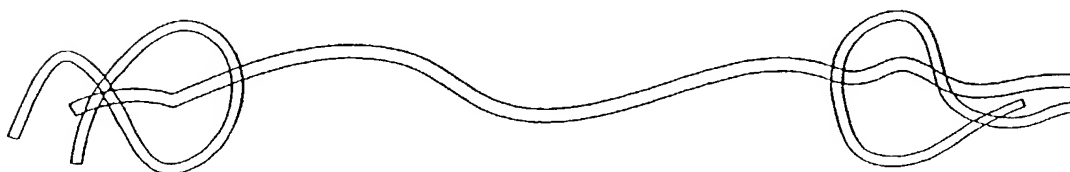


FIG. 7B

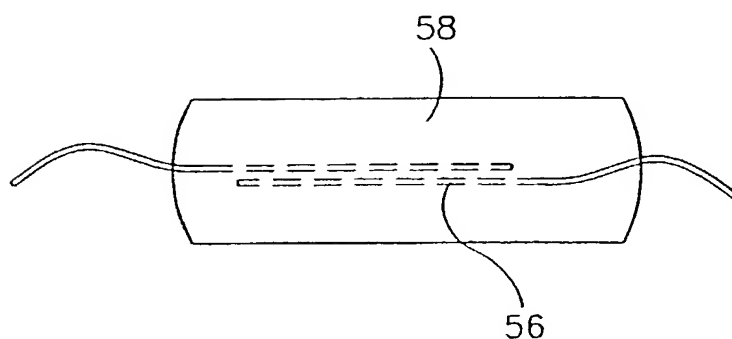


FIG. 8A

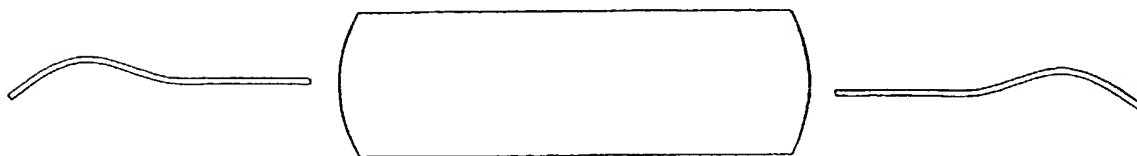


FIG. 8B

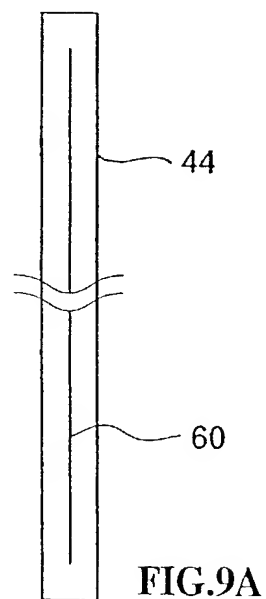
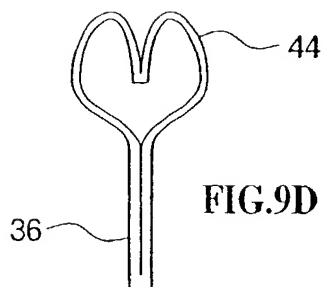
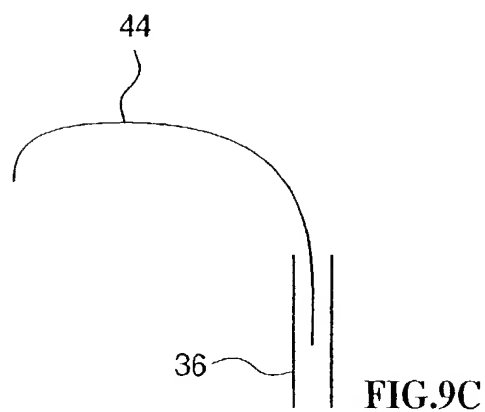
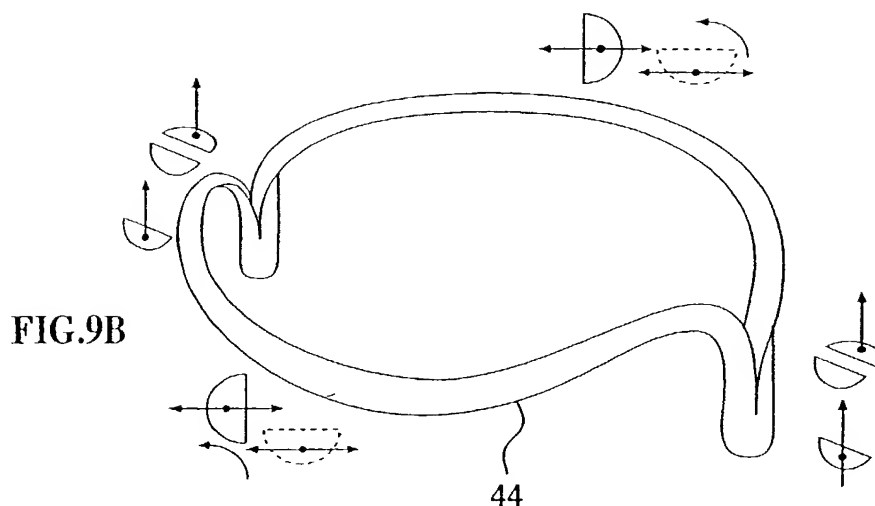
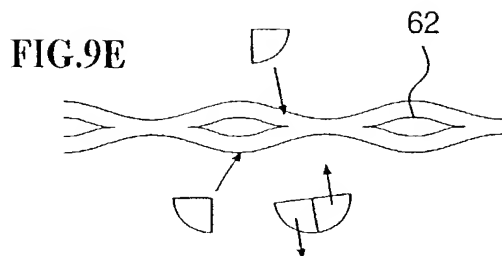


FIG.1 (PRIOR ART)

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

FRIEDMAN, Mark, M.
Beit Samueloff
Haomanim Street 7
67897 Tel Aviv
ISRAËL

Date of mailing (day/month/year)

24 November 2000 (24.11.00)

Applicant's or agent's file reference

1934/3

IMPORTANT NOTIFICATION

International application No.

PCT/IL00/00553

International filing date (day/month/year)

10 September 2000 (10.09.00)

1. The following indications appeared on record concerning:



the applicant



the inventor



the agent



the common representative

Name and Address

RAFAEL MEDICAL TECHNOLOGIES LTD.
c/o Corporate Service Bureau
15 East North Street
Dover, DE
United States of America

State of Nationality

US

State of Residence

US

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:



the person



the name



the address



the nationality



the residence

Name and Address

RAFAEL MEDICAL TECHNOLOGIES INC.
c/o Corporate Service Bureau
15 East North Street
Dover, DE
United States of America

State of Nationality

US

State of Residence

US

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:



the receiving Office



the International Searching Authority



the International Preliminary Examining Authority



the designated Offices concerned



the elected Offices concerned



other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Marie-Thérèse Priser

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

FRIEDMAN, Mark, M.
Beit Samueloff
Haomanim Street 7
67897 Tel Aviv
ISRAËL

Date of mailing (day/month/year) 08 December 2000 (08.12.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 1934/3	
International application No. PCT/IL00/00553	International filing date (day/month/year) 10 September 2000 (10.09.00)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address RAFAEL MEDICAL TECHNOLOGIES INC. c/o Corporate Service Bureau 15 East North Street Dover, DE United States of America	State of Nationality US	State of Residence US
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address RAFAEL MEDICAL TECHNOLOGIES INC. c/o Corporate Service Bureau 15 East North Street Dover, DE 19901 United States of America	State of Nationality US	State of Residence US
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:
ZIP CODE

4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned
☒ the International Searching Authority ☐ the elected Offices concerned
☐ the International Preliminary Examining Authority ☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Marie-Thérèse Priser
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Combined Declaration For Patent Application and Power of Attorney

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled INTRAVASCULAR DEVICE AND METHOD USING IT, the specification of which

(check one) ☒ is attached hereto.

☐ was filed on _____ as Application Serial No. _____ and was amended on _____. I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119, 365 or 371 of any foreign patent or application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

IL00/00553 PCT

(number) (Country)

131863 IL

(number) (Country)

(number) (Country)

10-Sep-00
(Day, Month, Year Filed)

10-Sep-89
(Day, Month, Year Filed)

(Day, Month, Year Filed)

(Day, Month, Year Filed)

Priority Claimed

☒ Yes ☐ No

☒ Yes ☐ No

☐ Yes ☐ No

☐ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States Application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)

(Filing Date)

Status

(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

Status

(patented, pending, abandoned)

I hereby appoint the following attorneys, with full power of substitution, association, and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Mark M. Friedman Registration No. 33,883

Address all Correspondence to:


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C/o Bill Polkinghorn
Discovery Dispatch
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Fax 001-3019529023

Attorney Docket: 1934/13
page 2 of 2

Continuation of Combined Declaration For Patent Application and Power of Attorney

I hereby further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statement may jeopardize the validity of the application of any patent issued thereon

*FULL NAME OF SOLE OR FIRST INVENTOR ELCHANAN BRUCKHEIMER	INVENTOR'S SIGNATURE 	DATE 2/2/02
RESIDENCE ESHKOL STREET 16, 30840 ZICHRON YAAKOV, ISRAEL	CITIZENSHIP ISRAELI	
POST OFFICE ADDRESS ESHKOL STREET 16, 30840 ZICHRON YAAKOV, ISRAEL		

*FULL NAME OF SECOND INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE	CITIZENSHIP ISRAELI	
POST OFFICE ADDRESS		

*FULL NAME OF THIRD INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE	CITIZENSHIP ISRAELI	
POST OFFICE ADDRESS		

*FULL NAME OF FOURTH INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE	CITIZENSHIP ISRAELI	
POST OFFICE ADDRESS		

*FULL NAME OF FIFTH INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE	CITIZENSHIP ISRAELI	
POST OFFICE ADDRESS		

*FULL NAME OF SIXTH INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE	CITIZENSHIP ISRAELI	
POST OFFICE ADDRESS		